

PART SEVEN

MINE PAGER PHONE TO PUBLIC
TELEPHONE INTERCONNECT SYSTEM

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PART SEVEN

MINE PAGER PHONE TO PUBLIC TELEPHONE INTERCONNECT SYSTEM

INTRODUCTION

This Part describes a mine pager phone to public telephone interconnect system that permits mine paging telephones to be selectively interconnected with the public telephone system, as illustrated by Figure 1. This interconnect concept was first conceived and demonstrated in breadboard form by H. E. Parkinson of Industrial Hazards and Communications, PMSRC, as one means for providing improved emergency and off-hours communications. The third-generation prototype unit described in this Part was designed and fabricated by Arthur D. Little, Inc. This unit is a small desk-top or wall-mounted unit that connects directly to both the public telephone line and the mine pager phone line, and requires no modifications to either the public dial telephone or mine pager phones. As part of this task, ADL also built, under a very compressed time schedule, a second-generation prototype unit suitable for reliable demonstration of the interconnect concept during the Bureau's technology transfer seminar on mine communications in March 1973.*

A major objective of the design of the third-generation unit described in this Part was that it be compatible with present mine pager phone systems utilizing DC voltage on the mine phone line to activate the phone loudspeakers. Therefore, this unit was designed to operate in a push-to-talk, push-to-listen mode that accommodates the inherent design differences and operation modes of the mine phones of different manufacturers. Though this push-to-talk, push-to-listen mode of operation may seem slightly unusual at first sight, we have found it is easily learned by new users. However, mine phone manufacturers wishing to expand their product lines with such an interconnect system will probably find it to their advantage to customize the design of this system to their particular mine phones, thereby utilizing the unique attributes offered by their individual product lines. This customization should not be difficult, and Section III below suggests some of the features that can be easily added to future designs. Detailed parts lists and circuit schematics for the present third-generation prototype system can be obtained from the system manual submitted to PMSRC and placed on public file.

* Manufacture of a new version of this interconnect unit has since been undertaken by a major manufacturer of mine communication equipment.

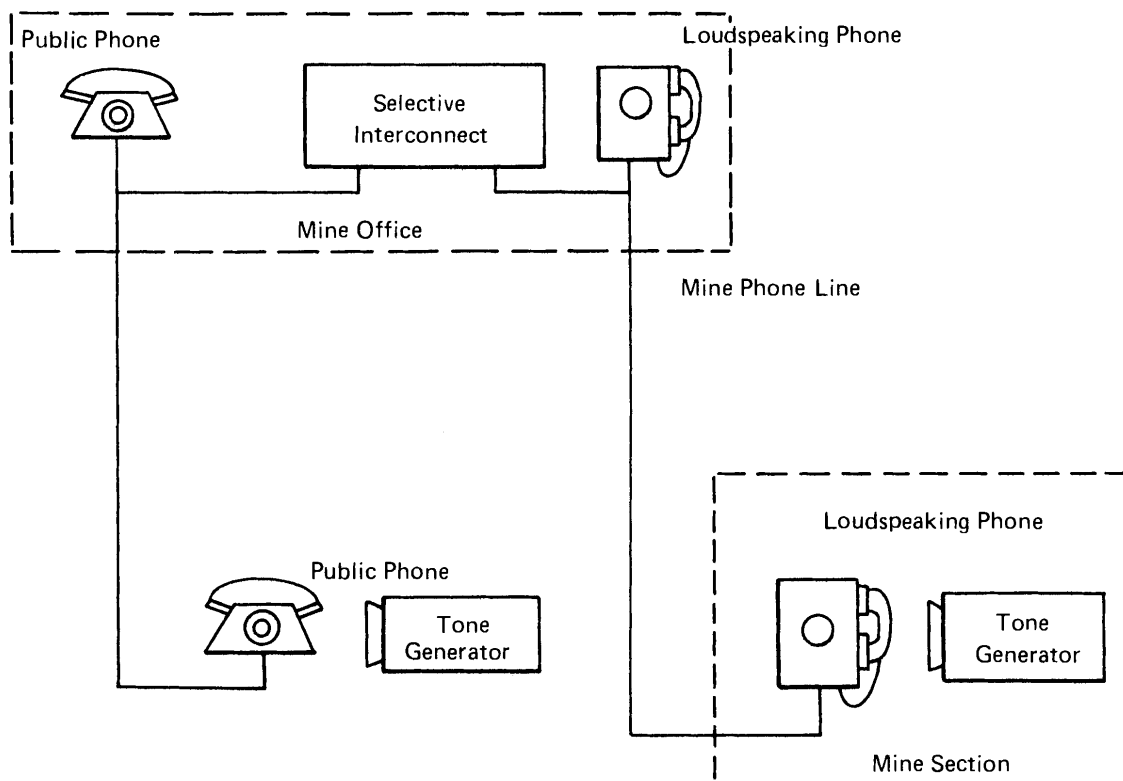


FIGURE 1 SELECTIVE INTERCONNECT BETWEEN MINE PAGER PHONE AND PUBLIC TELEPHONE SYSTEMS

I. OPERATIONAL DESCRIPTION

A. OVERVIEW

The Mine Pager Phone to Public Telephone Interconnect System is a Push-to-talk, Push-to-listen system designed to allow any mine pager system using DC voltage on the line to page, to be connected to the public telephone system. The system allows authorized personnel to communicate from the public telephone system into the mine pager system and vice versa.

An outside caller dials a telephone number assigned to the mine. Then, he gains access into the mine pager system by transmitting a proper tone from a hand-held tone generator into his phone for five seconds. Once access is gained into the mine pager system the tone is transmitted over the loud-speaker system for a few seconds, signalling that an outside call is coming in. The caller then pages over the loudspeakers until the page is answered.

The various mine pager systems have functionally similar switches located in different places and operate in slightly different fashion. All of these systems will be operated normally when used in conjunction with the Interconnect system with the exception of additional switching of the Page switch. This operational description will only describe operations that are in addition to those normally required to operate the mine pager phone.

The person in the mine answers the page by momentarily depressing the Page switch, which allows him to speak and also removes the paging signal from the line, disconnecting the loudspeakers. (The MSA system designates this switch as the Push-to-Page switch and it is located on the handset; it is called the Page Button on the Gai-Tronics system and is located on the front panel; the switch is also located on the front panel of the Femco system and is designated the Page switch.) To carry on a two-way conversation the user of the mine phone must momentarily depress the Page switch each time he wishes to change from the talk mode to the listen mode or vice versa.

The Interconnect system also works in the reverse direction, from the mine onto the outside telephone system. The in-mine user removes the handset from the mine phone and with the proper hand-held tone generator applies a tone into the mouth-piece of his handset for five seconds. The tone activates the Interconnect system which automatically dials a preprogrammed telephone number. The telephone number is programmed by setting the number on the thumb-wheel switches on the front panel of the Interconnect system housing. External and internal photographs of the interconnect system are shown in Figures 2 and 3. Detail operational descriptions of the incoming and outgoing call sequences are given below. Operation of the system during each of these sequences can be followed on the overall flow diagram in Figure 4.

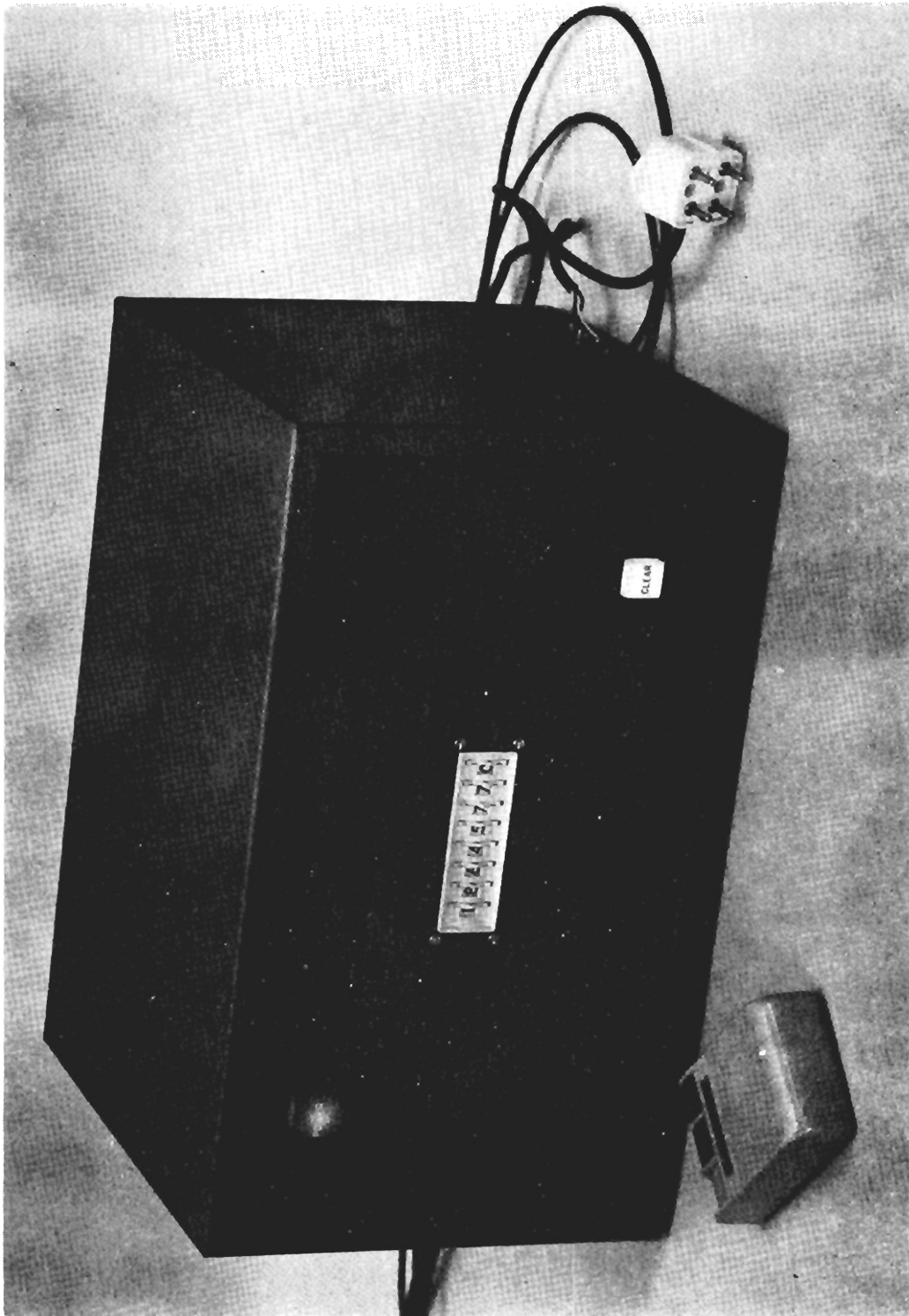


FIGURE 2 MINE PAGER TO PUBLIC TELEPHONE
INTERCONNECT SYSTEM

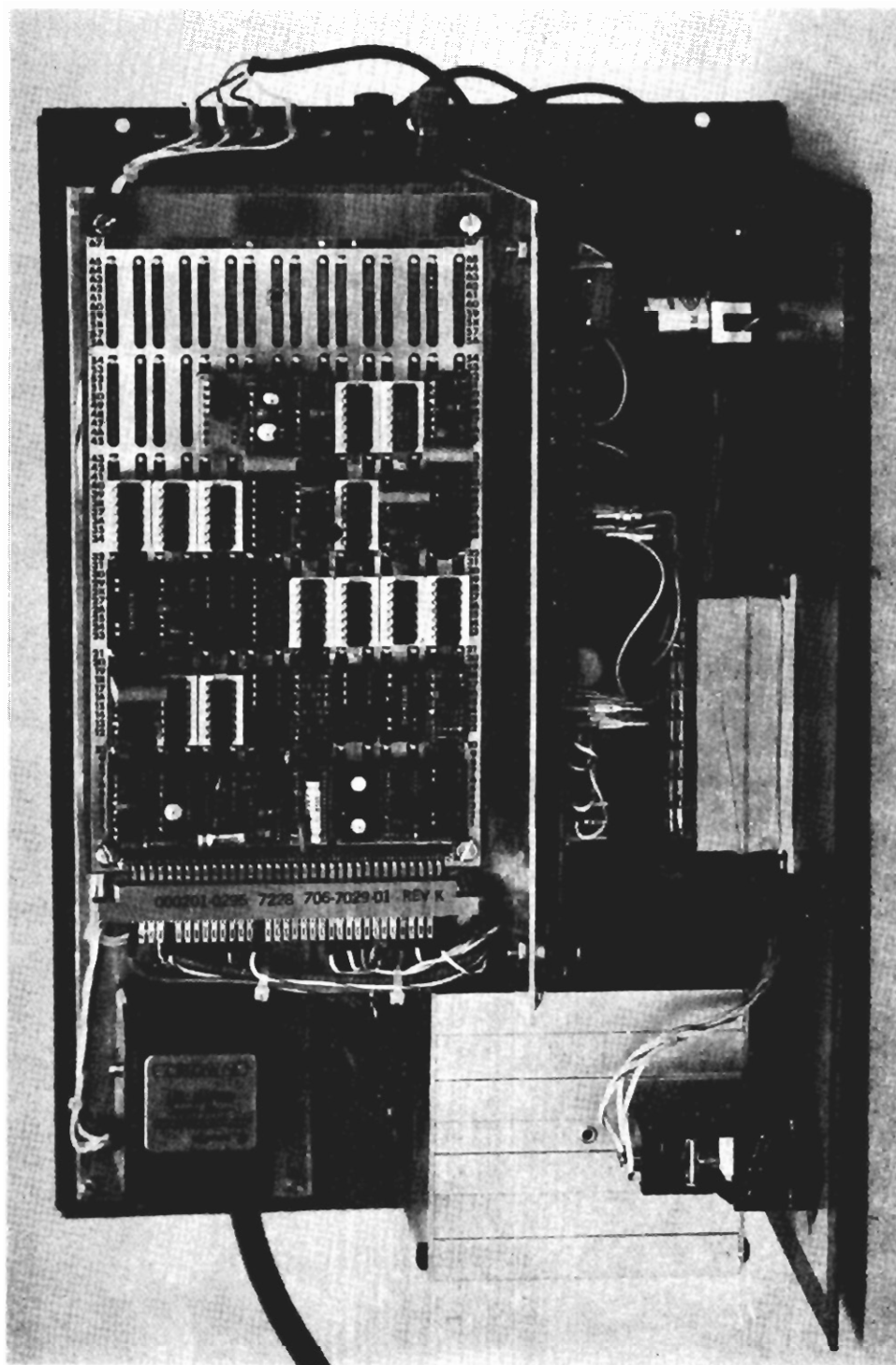
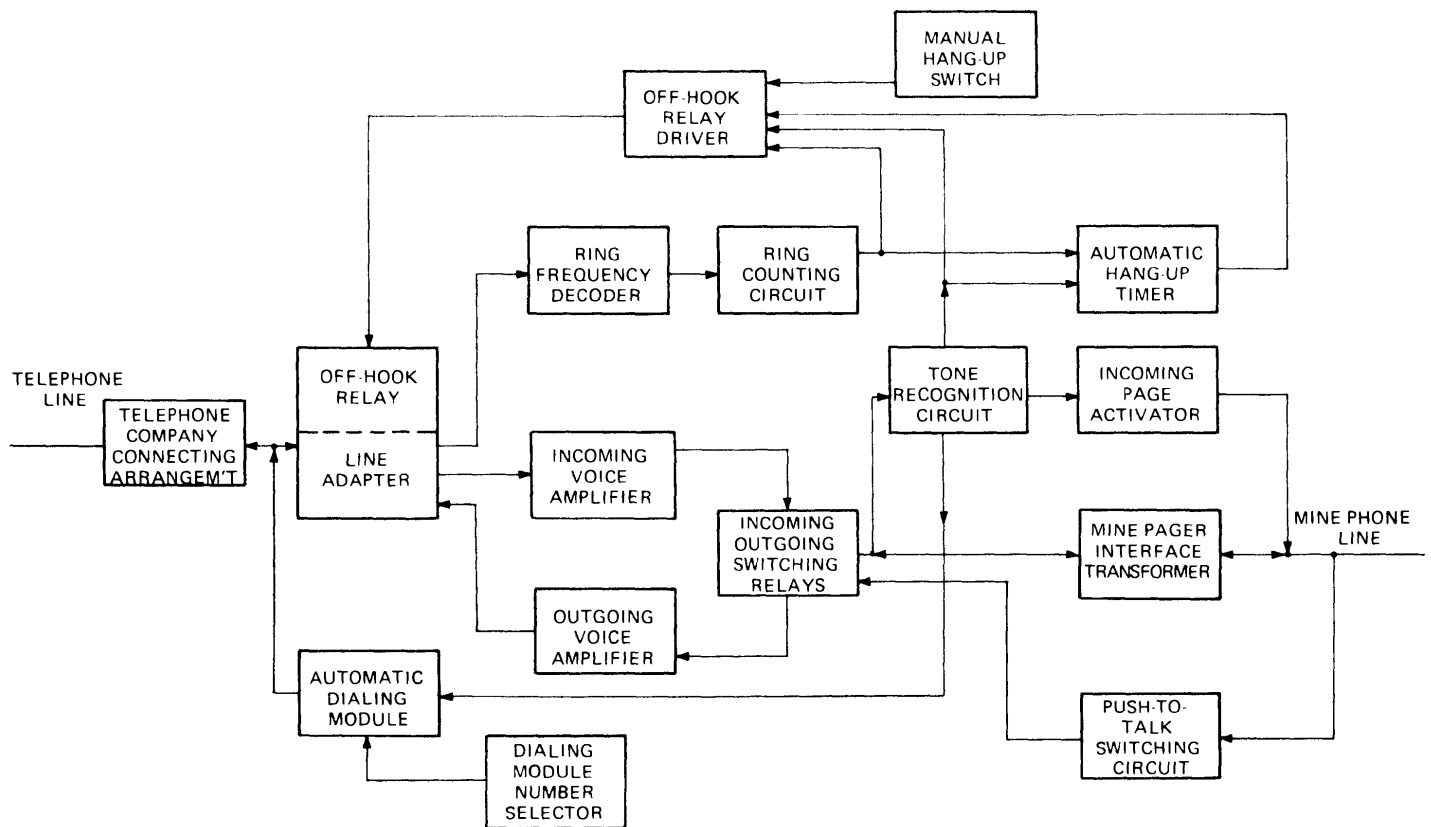


FIGURE 3 INTERCONNECT SYSTEM
INTERNAL TOP VIEW



**FIGURE 4 OPERATIONAL FLOW DIAGRAM
MINE PAGER TO PUBLIC TELEPHONE
INTERCONNECT SYSTEM**

B. INCOMING CALL SEQUENCE

To actuate the Interconnect system from an outside telephone, the caller must first know the telephone number of the system and must also have the proper frequency tone generator. Possessing these, the caller dials the number, which generates the ring signal. The ring goes over the telephone lines, through the telephone company's connecting arrangement and the transformer of the Crown Adapter and into the ring frequency decoder. The ring frequency decoder is designed to discriminate against all signals except the 20 Hz ring signal generated by the telephone system. The output of the ring frequency decoder goes to the ring counting circuit. When the circuit recognizes two rings, it drives the off-hook relay, "answering" the phone, and activates the automatic hang-up timer.

Once the phone has been automatically "answered", the caller must gain access to the mine pager system. In order to allow only authorized calls into the mine pager system, the Interconnect system uses a tone recognition circuit that is only activated by a proper frequency tone. Thus an authorized caller has only to generate that tone into the mouthpiece of his phone for five seconds. This tone is recognized, activating the paging portion of the mine pager system through the Incoming Page Activator. The caller may then talk over the loudspeakers of the mine phones paging the person to whom he wishes to speak.

If, once the call is "answered", the proper frequency tone is not transmitted into the system within 20 seconds, the system will be "hung-up" by the automatic hang-up timer. This allows off-hook time due to improper calls to be kept to a minimum.

When the page is answered, the answerer must momentarily depress the Page switch of the mine phone. This activates the Push-to-talk switching circuit which serves a twofold purpose. One, it disconnects the loudspeakers in the mine system and two, it opens the incoming relay and closes the outgoing relay of the Interconnect system. The answerer can then talk into his handset through the outgoing voice amplifier to the telephone system. When he has finished talking, he must again momentarily depress the Page switch in order to listen. The Page switch must be depressed each time the transmission mode changes. In other words, pushed to talk and pushed again to listen. The button need not be held in, as a matter of fact, it is best not held in since this would cause the conversation to be broadcast over all the loudspeakers in the mine pager system.

There are two normal methods of disconnecting the mine pager system from the telephone system. One is manually, after the

end of the conversation, and the other is automatically, after a specified time. In order to manually hang-up the system, a tone has to be transmitted into the handset mouthpiece by either the caller or the answerer. This tone again goes through the tone recognition circuit which decodes it and removes the drive from the off-hook relay, "hanging the phone up". The automatic hang-up occurs when the hang-up timer turns off after six minutes, removing the drive from the off-hook relay. The automatic hang-up feature insures that the Interconnect system will not be disabled for more than the preset time because of an incorrect hang-up. The system may also be manually hung-up in an emergency by using the manual hang-up switch, labeled "Clear", on the front panel of the Interconnect system's housing. This lighted pushbutton, when lit, indicates that the system is in the off-hook mode. If need be, the system can be hung-up by pushing this push-button, which hangs up the system, extinguishing the lamp.

C. OUTGOING CALL SEQUENCE

An outgoing call can be originated from any mine pager phone connected to the Interconnect system. Again, only authorized personnel can call out since a proper frequency tone generator is needed. When someone wishes to call out, he goes to the nearest mine phone and removes the handset from its cradle. He then transmits the tone into the handset mouthpiece for five seconds. It should be noted that this is the same as talking; and if the system in use requires depression of a Talk switch, this must be done.

The generated tone goes to the tone recognition circuit where it is decoded, thereby activating the automatic hang-up timer and driving the off-hook relay in the Crown Adapter, "picking up the phone". Simultaneously, the relay of the incoming amplifier is activated, as is the automatic dialer.

The automatic dialer is a module in the Interconnect system with a programmed number than can be manually selected in the mine office. When it is activated by the tone decoder circuit, it automatically dials that number. Thus the caller has no ability to determine the number dialed, just the ability to have it dialed.

Once the number is dialed, the caller can listen to the ring and hear when the outside phone is answered. The caller must then momentarily depress the Page switch, which opens the incoming relay and closes the outgoing relay in order for the inside caller to be heard by the outside party. The Page switch must be momentarily depressed each time the transmission mode changes.

The hang-up modes are exactly the same as in the incoming call sequence: manually, a tone must be generated; or automatically, when the automatic hang-up timer times out. Also the emergency manual hang-up switch can be used to clear the system.

II. SUMMARY OF OPERATIONAL FEATURES

A. PRESENT DESIGN

- (1) Direct connection to outside telephone lines. No acoustic coupler required.
- (2) Direct connection to mine pager phone line. No acoustic coupler or pager phone modifications required.
- (3) System compatible with any mine paging system utilizing DC voltage on the line to enable paging.
- (4) Only authorized personnel can use system. Proper frequency tone is needed.
- (5) Pocket-sized tone generator is all that is required for authorized person to initiate call.
- (6) Standard 8-pin dual-in-line integrated circuit used for tone recognition.
- (7) Designated tone frequency completely variable, being determined by a resistor and/or capacitor, thus system is compatible with all tone generators.
- (8) Tone transmitted over loudspeakers to signal incoming outside call.
- (9) Outside caller can page over mine pager system loudspeakers.
- (10) Convenient dial-out number selection via thumb-wheel switches located on interconnect unit housing.
- (11) System automatically dials preprogrammed outside telephone number.
- (12) Automatic hang-up timer. System only off-line for 20 seconds due to wrong number and six minutes due to incorrect hang-up.
- (13) Manual hang-up switch allows automatic hang-up timer to be overridden. System can be cleared instantaneously from interconnect unit.
- (14) Small-sized unit can be easily mounted on a table or wall bracket.

B. ADDITIONAL FEATURES FOR FUTURE DESIGNS

- (1) Dual frequency detection allowing either of two numbers to be dialed automatically, or one of several by tone combination.
- (2) Status indicator lamps.
- (3) Complete duplex system eliminating Push-to-talk operation.
- (4) Operation with 24 volt systems.
- (5) Audio warning signal one minute prior to automatic hang-up.
- (6) Retriggering of automatic hang-up timer through use of second tone, thereby extending conversation time beyond six minutes.
- (7) Interconnection of two separate mine paging systems in different mines by using two Interconnect units.

III. INSTALLATION PROCEDURE

In order to connect a mine pager phone system to the Mine Pager Phone to Public Telephone Interconnect System, it must meet two criteria: first, the Pager system must use 12 volts DC to activate its paging circuit and second, it must be installed with all cable connections observing polarity. If these requirements are met, the Interconnect system will enable the mine pager phone system to interconnect with the public telephone system.

The actual installation of the Interconnect system is simple and can be performed by any mechanic. The first connection made is the connection to the Mine Pager Phone cable. This requires connection of the two wires of the pager cable to the Pager Connection binding posts on the Interconnect system housing. As stated above, polarity must be observed, with the + side of the batteries going to the + (red) post and the - side to the - (black) post.

The next connection required is the connection to the telephone company supplied connecting arrangement. This just entails matching four wires to their appropriate colors on both the connecting arrangement and the Interconnect system housing. Thus, red goes to red, green to green, yellow to yellow and black to black. This connects the mine pager phone system to the telephone line through the Interconnect system.

The final connection is simply plugging in the line cord of the Interconnect system to an AC outlet. The entire system can then be energized by pushing the POWER switch on the front panel of the Interconnect Unit housing. This lightened push-button switch will light, verifying that the system is energized and operable.

It should be noted that the telephone company supplied connecting arrangement may vary among the local telephone companies. The connecting arrangement will entail fixed charges which have been spelled out in the local telephone tariffs. In order to comply with the telephone tariffs the local telephone company should be informed by the mine that a customer furnished telephone device is being interconnected with the public switched network. Contact should be made with the local telephone company accounts manager responsible for telephone service to that mine. The accounts manager will then identify the proper technical telephone company employee who can identify which telephone company voice interconnecting arrangement is suitable from a standard list available from the telephone company. At that time the telephone company should be in a position to supply the following information:

- lead time required for installation of the arrangement,
- one time installation charge,
- monthly charges thereafter.

We expect that the above charges will fall in the range of \$50-\$75 for installation and \$5-\$10 per month.